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UPPER COCOLALLA CREEK
(tributary to Cocolalla Lake)

Waterbody Type: stream
Ecoregion: Northern Rockies
Designated Uses: None; Existing uses are domestic and agricultural water supply, primary and secondary contact recreation and cold water biota
Size of Waterbody: 15.5 miles
Size of Watershed: 16,980 acres
Indicators:

Summary: Cocolalla Creek was determined to be impaired for sediment and temperature pollution. Sediment load target was set at 673.5 tons/yr from the existing load of 5,745.9 tons/yr. Temperature will not be addressed at this time pending an anticipated change to this standard.

1. Physical and Biological Characteristics

Upper Cocolalla Creek is the largest tributary to Cocolalla Lake. The creek contributes the highest proportion of inflow and phosphorus loading to the lake. Upper Cocolalla Creek drains approximately 16,980 acres of mixed land uses, including pasture and hayland (15%), forest land (83%) and residential use, including roads (2%). It flows from the headwaters southwest toward Careywood, Idaho, then turns north and flows into Cocolalla Lake. Elevation ranges from 2080 feet (634 m) at the mouth to 2460 feet (750 m) at the headwaters. Due to the mixed geology and the effect of the Lake Missoula floods, Cocolalla Creek exhibits an irregular drainage pattern, with numerous ponds, sinks, and wet areas. The creek is perennial with the flow regimen dominated by snowmelt runoff. It is approximately 15.5 miles long from the headwaters to the mouth with many small intermittent tributaries throughout its length. Cocolalla Creek originates at Little Blacktail Mountain (elevation 3800 ft), and eventually drains into the south end of Cocolalla Lake (Gilmore 1996).

Cool, dry summers and moderately cold winters characterize the area. Average annual precipitation ranges from 25 to 30 inches (63.5 to 76.2 cm). The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events.

The headwaters originate at the eastern edge of the watershed at an elevation of 3800 ft. For the first 4.5 miles the creek drains forested land of greater than 25% slopes, and falls at an average 6% gradient until it reaches elevation 2440 ft, which is the beginning of the first valley floor. There are about 2 stream miles through this valley which at one time had substantial grazing activity, but this has lessened in recent years. In some stretches the creek becomes braided, and there are also pools due to beaver activity. At the end of the valley Cocolalla Creek receives Kreiger Creek and Three Sisters Creek, which drain the southeastern corner of the watershed (Rothrock 1995).

The watershed is heavily forested with foothill and mountainous terrain up to 4500 ft elevation and slopes ranging from 15-50%. There has been considerable logging activity and most

timbered areas are second growth. The lower portion of the Cocolalla Creek watershed is characterized by pasture and hay ground and cattle and sheep grazing, with free access to riparian areas.

Geology. Most of the Cocolalla Creek watershed is the Belt series. Cocolalla Lake is bordered by batholith granites near Black Pine Mountain. The bedrock consists mainly of the Selkirk Crest quartz monzonite (Tertiary) and metamorphic rocks (Precambrian). The valleys are filled with sediments from current erosion of the mountains, lake deposits, glacial till and outwash. The combination of highly erodible soils, steep slopes, and large drainage area relative to the capacity of the streams makes these streams highly susceptible to sediment overload.

Soils. The predominant soils of the Cocolalla Creek watershed can be grouped into the following three general soil mapping units:

Pend Oreille-Rock Outcrop-Treble:

Very deep, well drained, rolling to very steep soils, and rock outcrop. Moderate permeability, rapid to very rapid runoff, high to very high erosion hazard. Unit is considered poorly suited to roads, dwellings, and recreational development due to slope, erosion hazard, and rock outcrop.

Bonner-Kootenai:

Very deep, well drained, level to hilly soils, slow runoff, slight erosion hazard. Unit is suited to hay, pasture, and livestock grazing.

Hoodoo-Pywell-Wrenco:

Very deep, level to nearly level, poorly drained to very poorly drained on low stream terraces, flood plains, and bottomlands. Very slow runoff, subject to very long periods of flooding. Unit is well suited for hay, pasture, and livestock grazing.

Land Use. A large portion of the watershed is comprised of dense canopy conifer forest. Open canopy forests have been selectively logged as a forest management practice. Currently, the watershed, as with other areas of Bonner County, is experiencing tremendous rural development. Some of the selective logging (and clear-cuts) is occurring on 20 acre parcels using erosion control measures under the Idaho Forest Practices Act, followed by private development of homesites, roads, and driveways in which there is a lack of erosion control practices (Gilmore 1996).

Agricultural cover is mainly pasture and hayland. Pasturelands are used primarily for livestock grazing and the majority of acres are located along lower Cocolalla Creek bottomland subject to flooding. Some of the larger fields are harvested for one cutting of hay and then utilized as pasture during the summer and fall months. Open meadow cover type includes upland grass areas used for summer pasture land. This land is generally located on upland soils with up to 20% slopes (Rothrock 1995).

2. Pollutant Source Inventory

The factors currently found to be impairing Beneficial Uses and water quality in Upper Cocolalla Creek are sediment and thermal modification. Current boundaries for the water quality limited segment are from the confluence with Cocolalla Lake to its headwaters.

Point Source Discharges.

There are no known point source discharges to Upper Cocolalla Creek or its tributaries.

Nonpoint Source Discharges

Many non-point sources of pollution were identified and noted in the Final Report of the Cocolalla Creek Local Working Committee as prepared by Clark (1991). These sources included the following in order of relative importance:

Silviculture. There are approximately 14,407 acres of forest land within the Cocolalla Creek watershed. Much of this watershed is covered with densely forested areas, consisting of conifers including Douglas fir, grand fir, ponderosa pine, and lodgepole pine. A significant portion is covered with open forest land which has been selectively logged. Some large blocks of forested land are managed by the U.S. Forest Service. Other public lands are managed by the U.S. Bureau of Land Management, and the Idaho Department of Lands. Most of the land is under private ownership.

Harvest activity occurred throughout the watershed at a brisk rate in the early 1990's. In 1994, the Idaho Department of Lands office in Sandpoint, Idaho issued 148 Certificates of Compliance-Fire Management Agreement/Notification of Forest Practice within the Cocolalla Lake watershed (Gilmore 1995).

Agriculture and Grazing.

Pasture condition was rated on forage quality, grazing management levels, soil condition, and erosion potential. Results of this survey was that approximately 80% of the pastures are in good condition, 10% in fair condition, and 10% in poor condition (Gilmore 1995).

Stream zones associated with grazing were rated according to the quality of riparian vegetation, streambank stability, and streambank erosion potential. Estimates indicate approximately 80% of the streambanks are in good condition, 10% in fair condition, and 10% in poor condition (Blew 1995).

Cocolalla creek flows from forest land through hay and pastureland. Many of the channels have been physically altered or straightened. This has impacted the hydrology of the system by changing the timing and volume of stream flows. Riparian vegetation on the straightened sections is in poor condition, with the woody component completely lacking or decadent. This increases the potential for channel erosion during spring runoff flows. This also increases the vulnerability and erosion potential of the banks when exposed to mechanical impacts from livestock. Sediment from sheet and rill erosion on the pasture and hayland is insignificant, since most fields are flat 0-3% slopes, and have 70-95% vegetative cover.

Roads. An estimated 2% of the watershed are included in roadways. This does not include the miles of active and inactive forest roads. When inactive roads are factored in, road densities in

the watershed exceed 5 to 6 miles per section, which can significantly affect the drainage patterns and overall hydrology of the system, including sediment transport (Gilmore 1995).

Sediment is generated by roads because drainage facilities and other sediment control measures have not been installed in many areas. The roads generally have shallow side ditches but very few relief or cross culverts. As the runoff water drains from the road surface, it is collected in the roadside ditches and then continues to grow in terms of flow, velocity, and sediment transport. The discharge points for most of these ditches is directly to the stream.

Road surfaces are often observed to encourage rill and gully erosion. Cut slopes are often steep and have little chance for revegetation, leaving exposed soil surfaces. Fill slopes also are often too steep to become revegetated and they continue to contribute sediments to down slope areas or directly into the streams (Gilmore 1995).

Unsurfaced roads contribute sediment at a greatly accelerated rate. The roads which have the greatest impact are associated with those near the stream and improperly maintained or abandoned logging roads in the forested areas. Erosion rates have been estimated as high as 7 tons per acre/year for road surfaces and side slopes (Stevenson 1996).

Residential development (urban wildland interface). The Cocolalla Creek watershed is experiencing tremendous development. An estimated 300 acres per year are subdivided with the majority of the development occurring on 20 acre parcels following forest land harvest activities. Erosion control practices, installed on the forest land under the Forest Practice Act, are destroyed and removed during construction. Opportunities for erosion increases as contractors and developers excavate for home sites and driveways during the critical erosion periods. Rural land divisions creating parcels 20 acres or larger are currently exempt from the county subdivision ordinance. There is a lack of enforcement on these larger developments and contractors and developers are generally not planning or implementing erosion control or storm water management plans. Erosion control plans or storm water management plans for residential construction are required as a condition of building permit issuance by Bonner county, but lack enforcement.

2.a. Summary of Past and Present Pollution Control Efforts

The Cocolalla Lake Association was formed in 1985 with a stated goal of "reversing the lake eutrophication process and preserving its beneficial uses. The Association has developed contacts with and promoted actions from federal, state, and county agencies to encourage surveys and regulations for reducing nonpoint nutrients and sediment into the lake. Various formats have been used to educate local residents and visitors in using practices which lessen pollution. Association members have also conducted a watershed inventory and mapping.

In 1986 the Cocolalla Lake Association contracted with Dr. Michael Falter of the University of Idaho to conduct a one-year study with the objectives of describing current lake conditions (determined to be phosphorus limited meso-eutrophic), estimate nutrient loading, and provide a computer model for predicting lake response to watershed management options (Falter and Good, 1987). A very useful result from that study was an extensive literature search on phosphorus export coefficients from various watersheds and nonpoint sources. By defining the

hydrology, dimensions, and land uses within the Cocolalla Lake watershed, a table of phosphorus export coefficients was selected as best estimates for the particular characteristics of the Cocolalla watershed.

In August 1990, DEQ was awarded funding of an Environmental Protection Agency Clean Lakes Phase 1 grant. A diagnostic monitoring program of the Cocolalla Lake watershed was conducted by DEQ from October 1990 through September 1991. An extension of the program provided some further site specific sampling from December 1991 to September 1992. Also in 1990, Upper and Lower Cocolalla Creeks and Cocolalla Lake were designated as Stream Segments of Concern under the Idaho Antidegradation Program. A Local Working Committee was formed which developed water quality objectives and site specific Best Management Practices for these areas (USDA-SCS 1992).

In 1993, the Cocolalla Lake Steering Committee selected James M. Montgomery Consulting Engineers, Inc. to conduct a feasibility analysis of watershed and lake restoration options, and to help formulate a lake management plan. It was completed in 1996 with five targets identified to reduce cultural eutrophication of Cocolalla Lake.

3. Water Quality Concerns and Status

The 1992 Idaho Water Quality Status Report (IDEQ 1992) reported that cold water biota and salmonid spawning were partially impaired in Upper Cocolalla Creek. This was confirmed based upon evaluations of the stream segment using the Beneficial Use Reconnaissance Project data gathered in 1995 and 1998. In addition to this listing, Cocolalla Creek is under scrutiny as a major contributor of nutrients to Cocolalla Lake. This Lake is impaired due to nutrients and dissolved oxygen.

3.a. Applicable Water Quality Standards

Upper Cocolalla Creek was listed for sediment and thermal pollution in the 1996 303(d) list. The Idaho Water Quality Standards narrative criteria (IDAPA16.01.02.200) states that sediment shall not exceed, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Such impairment is determined through water quality monitoring. Monitoring conducted in 1991 showed that sediment was limiting beneficial use attainment (Rothrock 1995).

Temperatures for cold water biota and salmonid spawning (IDAPA 16.01.02.250) must be 22°C or less with a maximum daily average of no greater than 19° C. During spawning periods and incubation for particular species of salmonid, water temperature must be 13° C or less with a maximum daily average no greater than 9°C. Temperature exceedances will not be addressed until proposed new temperature standards have been finalized.

3.b. Summary and Analysis of Existing Water Quality Data

Streambank Erosion Rates. Isolated, short sections along the channels are eroding at moderate rates. This is generally associated with livestock crossings, urban development, and hydrologic impacts. Streambank erosion rates on the remaining stream section are nearly "background" or geologic rather than accelerated (Stevenson 1996).

According to Stevenson (1996), the riparian and pasture condition inventories estimated 80% of the streambanks in good condition, with 10% in fair and 10% in poor condition. The good condition areas were considered "background" erosion rates. The areas in good condition are estimated to contribute .0098 tons/year/linear foot of channel while the areas in poor condition contribute .0315 tons/year/linear foot of channel.

Flow. An account of monthly average discharge and flow volume for two stream sampling sites were recorded for Upper Cocolalla Creek from October 1990 through September 1991. This hydrograph showed three short duration high flow peaks of greater than 100 cfs between late winter and spring. The highest flow months of February through April had monthly volumes around 3,400 ac-ft. Over the study year the lower stream site recorded 5,000 acre-feet more than upper stream site. This is a 40% increase over five stream miles and drains about 25% of the total Cocolalla Creek watershed. An account of monthly average discharge and flow volume for sampling sites CC1 and CC2 are summarized in Table 3.

Table 3. Average Flow Velocity and Volume - Upper Cocolalla Creek
Oct. 1990-Sept. 1991

Station	Mean Discharge (cfs)	Max. Discharge (cfs)	Total Flow Volume (acre-feet)	% of total lake inflow
Cocolalla Creek CC1 (upper)	17.2	110	12,418	----
Cocolalla Creek CC2 (lower)	24.0	159	17,389	52%

Flow volumes in the watershed are significantly related to precipitation. The period of October 1991 through May 1992 was far below normal in precipitation and snowpack in north Idaho, and winter temperatures were quite mild. Peak flow on the lower Cocolalla Creek hydrograph was in late February with a maximum of only 47 cfs. From December through May the combined flow volume of Cocolalla Creek plus Fish Creek in 1992 was 65% less than 1991 (Rothrock 1995).

Phosphorus. Cocolalla Creek provides about 40% of the total Cocolalla Lake inflow and is the single highest phosphorus importer to the lake (25% of the total phosphorus budget). Phosphorus loading increases substantially over the last seven miles of the creek with an apparent influence from grazing lands (Rothrock 1995).

Sampling done on Cocolalla Creek from October 1990 to September 1991 measured nutrients at two sites (CC1 - upper, CC2 - lower). Three samples at the lower site in February and early March produced above average TP values (0.031mg/L). These samples were on the upward slopes of hydrograph peaks. Sampling in rainy periods in October and November also produced above average phosphorus values. This likely reflects initial wet season nutrient runoff from summer accumulation of animal wastes on the grazing lands. Dissolved ortho-phosphate concentrations ranged between 0.001 - 0.004 mg/L (Rothrock 1995).

Suspended Sediment. Similar to the trend in phosphorus values, Cocolalla Creek did not exhibit a high February total suspended sediment peak. Mean suspended sediment in the high runoff period of mid-February to May at the lower site (CC2) did average about 3mg/L more than the low runoff period of fall and early winter. During high flow, mean suspended sediment was nearly the same at both CC2 and upstream at CC1, indicating either low stream bank erosion in the flatland stretch between the stations, or rapid sediment settling (Rothrock 1995).

Nitrogen. Data analysis of total nitrogen concentrations are made with caution because of the poor quality assurance results for ammonia and TKN.

Cocolalla Creek site CC1 had the higher nitrate mean (0.208 mg/L), surprisingly slightly greater than the lower station CC2. Nitrate values were above the yearly mean in fall months, and then declined to around 0.20 mg/L and below in winter and spring. This was unlike total phosphorus which increased above the mean in February and March. Mean nitrate at CC1 and CC2 were nearly the same up to the June samples, while TP concentrations were consistently higher at the downstream site. Nitrate increased each month at the low flow period June through September, and concentrations were less at the downstream site. This may have been due to nitrate assimilation by attached algal growth and macrophytes which were abundant (particularly periphyton) in the lower stretch of the creek (Rothrock 1995).

Bacteria. Rothrock reported that on Cocolalla Creek at CC2 there was a high fecal strep count in the November 1991 sample, coinciding with high phosphorus and nitrogen values. In winter months there was only one sample with above average fecal strep and fecal coliform. During the low flow period of June through September coliform counts increased, reaching a high of 200 colonies/100 ml. In Cocolalla Valley there is livestock grazing in summer months, and observed direct animal contact in the stream. Over the year station CC2 was slightly higher in mean bacteria counts than CC1 (1995).

Physical Characteristics. At station CC2, electrical conductivity (EC) values in the summer and fall months at low flow ran between 100 - 150 μ mhos, and then dropped to 45 - 70 μ mho in winter and spring. In late summer on Cocolalla Creek the pH reached 8.0 units.

Summer downstream temperature measurements on upper Cocolalla Creek were 11 - 12°C, while downstream at CC2 the water had warmed to 13 - 14°C in the 1991 monitoring (Rothrock 1995). Beneficial Use Reconnaissance Project data collected August 1, 1995 in the lower portion of Cocolalla Creek reported an in-stream temperature of 21°C.

Dissolved oxygen maintained sufficient levels for salmonid fisheries in summer months. The lowest summer oxygen level recorded at CC1 and CC2 was in early August at 7.6 mg/L.

Antidegradation Reconnaissance - Habitat, Macroinvertebrates, Fisheries

A reconnaissance level monitoring under the Antidegradation Program was undertaken in the summer of 1991 by DEQ (DEQ, 1991). Both upper and lower stream segments were surveyed on Cocolalla Creek. The lower reach showed beneficial use impairment with unstable banks, pools and riffles sedimented, and substrate dominated by sand and silt. Macroinvertebrates were dominated by black fly larva. Mayflies and stoneflies were rare and there were no caddisflies found in lower Cocolalla Creek. Upper Cocolalla Creek above the first agricultural valley had an abundant and diverse macroinvertebrate community. The stream had good shade cover and an

abundance of pools formed by large organic debris.

Beneficial Use Reconnaissance Project (BURP) data collected in 1994 showed an unimpaired macroinvertebrate community in the lower portion of Cocolalla Creek, with a combined Macroinvertebrate Index (MBI) value of 4.26 collected 500 meters upstream from the confluence with Cocolalla Lake. In the upper reaches, BURP data recorded an MBI of 3.89, which also provides for full support status. 1995 BURP data in the lower reaches between these two sites showed an impaired community, with an MBI reported at 2.90.

USDA Preliminary Investigation.

Aquatic Habitat: Aquatic habitat was inventoried in Cocolalla Creek using an evaluation method patterned after the USFS "COWFISH" Model. Parameters inventoried include undercut banks, stream shading, vegetative overhang, streambank stability, cobble embeddedness, and width/depth ratio.

The evaluation of the lower reaches of the creek indicate that the fish habitat is in poor condition. The habitat is currently at approximately 40 percent of its potential. Parameters limiting fish populations include: high percent cobble embeddedness, low percent of overhanging vegetation, low percent of undercut banks, and low percent of stream shading.

Water Quality problems associated with this section of the creek were siltation and reduced diversity and prevalence of tolerant bottom dwelling aquatic organisms. The section was rated as poor to fair based upon evaluation for indicators of sediment, animal wastes, and nutrients. (USDA-SCS 1992).

Fish. In the 1950's, Cocolalla Lake was managed as a cutthroat trout fishery. In 1957 the Cocolalla drainage system received a rotenone treatment to eliminate spiny ray and trash fish, and then was planted with cutthroat. Since then, competition from warm water fish, decreasing water quality, and degradation of stream segments (including Cocolalla Creek) leading to spawning areas has made the lake marginal for natural trout production (Rothrock 1995).

A July 1987 survey of upper Cocolalla Creek by the Idaho Department of Fish and Game (Horner, 1988) was also summarized in the antidegradation report. Game fish species found were brown trout, rainbow trout, brook trout. Brook trout were the most numerous of the three salmonid species. The best salmonid habitat type was found in the upper reaches of Cocolalla Creek.

Snorkeling was conducted by DEQ personnel on July 29, 1993 at two sites in Cocolalla Creek. At the upper site, 17 brook trout and 2 sculpins were counted. Brook trout density was estimated at 17.4/100m². Most fish observed in the lower reach were cutthroat trout. Brook trout were also observed (Corsi 1995).

Electrofishing data collected by the IDEQ in 1997 approximately 500 meters upstream from the confluence with Cocolalla Lake showed four species of salmonids (Brook, Brown, Cutthroat, and Rainbow) and four other fish species (minnow, Bullhead, Sculpin, and Dace). The data was inconclusive for support status of salmonid spawning.

Historical Sampling. Nutrient loading calculations were made from stream monitoring in 1975. Cocolalla creek was identified as contributing the greatest amount of nutrients to Cocolalla lake. Reference was also made to stream impairment in Cocolalla Creek associated with heavy grazing and haying.

3.c. Data Gaps for Determination of Support Status

Bacteria sampling of Upper Cocolalla is needed to determine if there is an impairment of primary contact recreation use. Additional temperature recordings are also required.

4. Problem Assessment Conclusions

Upper Cocolalla Creek was determined to be a water quality limited segment by DEQ's waterbody assessment process. It was determined that the primary factors of concern are sediment and thermal modification. These pollutants are considered to be impairing cold water biota and salmonid spawning based upon beneficial use reconnaissance data and other data. The impairment determination was based upon a 1995 low macroinvertebrate index score of 2.90 and information from other macroinvertebrate community evaluations. Sediment data on Cocolalla Creek reflect a high percentage of cobble embeddedness, which impairs both the cold water biota and salmonid spawning beneficial uses. Temperature data indicated that in-stream temperatures may be too high to fully support salmonid spawning.

While the beneficial use reconnaissance data does not suggest primary contact recreation is an appropriate use for this stream, historical flow data does. High bacteria counts in November of 1991 and other dates indicate that the possibility of this occurring again should warrant further investigation into support status of this beneficial use.

5. TMDL - Loading Analysis and Allocation

Problem Statement: Impairment of cold water biota and salmonid spawning beneficial uses due to excess sediment.

5.a. Numeric Targets

(See attached spreadsheet)

5.b. Source Analysis

(see attached spreadsheet)

5.c. Linkage Analysis

(See below)

5.d. Allocations

(see attached spreadsheet.)

5.c. and 5.e. Monitoring Plan and Linkage Analysis

Because Idaho's Water Quality Standard for sediment is narrative and not based upon something directly measurable in the water column, a different approach is required to achieve a satisfactory monitoring plan. An analysis of the methods available for monitoring the success of TMDLs indicates that, in this case, more than one method should be used to verify the cause of the

impairment, track load reduction, and to show that the stream is moving towards full support. The sediment monitoring plan will include three parts:

1. Determination of support status using Beneficial Use Reconnaissance monitoring. If the conclusion of the survey is no impairment for two surveys taken within a five year time period then the stream can be considered restored to full support status.
2. Load reduction measures shall be tracked and quantified. For example, 1.2 miles of road obliteration near a stream, 0.5 miles of stream bank fenced, 5 acres of reforestation, etc.
3. Amount of sediment reduction achieved by implementation of load reduction measures shall be tracked on a yearly basis. For example, 1.2 miles of road obliteration will result in a 6 tons/yr reduction, 0.5 miles of stream bank fenced will result in a 3 ton/yr reduction, 5 acres of reforestation will result in a 0.7 ton/yr reduction, etc.

The reason for this three part approach is the following:

1. DEQ presently uses the Beneficial Use Reconnaissance data to indicate if the stream is biologically impaired. Often times this impairment is based upon only one Reconnaissance survey. The survey should be repeated to insure that the impairment conclusion is correct and repeated twice after implementation to determine if the (improved) support status conclusion is correct. Survey data may show an impairment in fisheries or macroinvertebrates and the cause of the impairment may point to sediment pollution. However, there is not a direct linkage between the pollutant and the impairment. Sediment could be indicated as the problem when, in fact, temperature might be the problem. The Reconnaissance data is not specific as to the cause, just that there is a problem. So using the Reconnaissance data alone to monitor the TMDL is not adequate.
2. There is great uncertainty about how much sediment actually needs to be reduced before beneficial uses are restored. These TMDLs use a very conservative approach, in that the sediment target is limited to natural background amounts. However, beneficial uses may be fully supported at some point before this target is achieved. Therefore, a measure of sediment reduction cannot be used exclusively to determine a return to full support.
3. Because TMDLs are based upon target loads measured in a mass per unit time there must be a method included to directly measure load reductions. Coefficients which estimate sedimentation rates over time based upon land use have been used to develop the existing loads. This same method can be used for land where erosion has been reduced. Road erosion rates are based upon the Cumulative Watershed Effects road scores. These scores can be updated as road improvements are made and the corresponding load reduction calculated.

5.f. Margin of Safety

Because the measure of sediment entering a stream throughout the entire watershed is a difficult and inexact science, assigning an arbitrary margin of safety would just add more error to the analysis. Instead, all assumptions made in the model have been the most conservative available. In this way, a margin of error was built into each step of the analysis. Explanations of some of the values have not been detailed as yet on the spreadsheets pending their revision. Background loading from land uses and stream bank erosion coefficients are being revised to be specific to the Pend Oreille watershed. Once the revised values are received the "Sediment Yield" portion of the spreadsheet will more fully explain the source of the values. For an explanation of how the Cumulative Watershed Effects data was collected and processed, refer to the Idaho Department of Lands manual titled, "Forest Practices Cumulative Watershed Effects Process For Idaho". One important detail to note when looking at how the Cumulative Effects data was used in the TMDL is that, although all forest roads in the watershed were not assessed, the field crews are directed to assess the roads most likely to be contributing sediment to the stream. This weighted the average road scores towards the ones most likely to be in poor condition.

References

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Upper Cocolalla Creek: Land Use Information

Land Use

<u>Sub-watershed</u>	<u>Upper Cocolalla Ck</u>
Pasture (ac)	2869
Forest Land (ac)	14407
Unstocked Forest (ac)	1109
Highway (ac)	80
Double Fires (ac)	448

Explanation/Comments

Includes once burned areas
State or County Paved Highways
Areas which have been burned over twice

Road Data

<u>Sub-Watershed</u>	<u>Upper Cocolalla Ck</u>
1. Forest roads (total miles)	92.1
CWE road score (av)	17.2
*Sediment export coefficient (tons/mi/yr)	3.8
#Total Forest Rd Failures (cubic yds delivered)	0

Cumulative Watershed Effects data

2. Unpaved Co.& priv. roads (total miles)	126
Paved Co.&priv. roads (total miles)	7.4
**Sediment export coefficient (tons/mi/yr)	25.5
Total C&P Rd Failures (cubic yds delivered)	0

Based on weighted average of forest road failures.

##Stream bank erosion-both banks (mi)

poor condition	6.3
good condition	7.8

**erosion coefficients

166.3 tons/yr/mi
51.7 tons/yr/mi

*McGreer et al. 1997

**Stevenson 1996. Recommends 7 tons/ac/yr for unsurfaced roads X 3.64 ac/mi road = 25.5 tons/yr/mi

#Total road failures are the amount of sediment observed by the CWE crews that was delivered to the stream. This amount is used to represent the yearly delivery to the stream. This is an over-estimate of sediment delivered to the stream since failures can continue to deliver to the stream for a number of years after they occur, however, in a much reduced quantity. One must also take into consideration that all failures were not observed, which is an under-estimate of delivered sediment. These two factors combined with on-site verification by a specialist in this field, makes these estimates a close approximation of actual conditions. To further refine the mass failure estimates one could assign a once in ten year occurrence to the largest failures which probably occurred during the floods of 1996.

##Source of data from 1996 aerial photos.

Sed. Yield

Upper Cocolalla Creek: Sediment Yield

Sediment Yield From Land Use

Watershed:	Upper Cocolalla Ck
Pasture (tons/yr)	157.8
Forest Land (tons/yr)	547.5
Unstocked Forest (tons/yr)	18.8
Highway (tons/yr)	2.7
Double Fires (tons/yr)	7.6
Total Yield (tons/yr)	734.4

Explanation/Comments

Acres by Land Use X Sediment Yield Coefficient = Tons Sediment/yr

Yield Coeff. (tons/ac/yr)

0.055

0.038

0.017 (this acreage is a subset of Forest Land acreage)

0.034

0.017 (this acreage is a subset of Forest Land acreage)

(Values taken from WATSED and RUSLE models see below explanation [#])

*Sediment Yield From Roads

Watershed:	Upper Cocolalla Ck
Forest Roads (tons/yr)	350.0
Forest Road Failure (tons/yr)	0
County and Private Roads (tons/yr)	3,210.50
Co. and Private Road Failure (tons/yr)	0

Miles Forest Rd X Sediment Yield Coeff. from McGreer Model

***Assumes soil density of 1.5 g/cc and a conversion factor of 2.189.*

Based on weighted average of forest road failures.

*Percent fines and percent cobble of the Vay/Pend Oreile/Bonner/Hoodoo series B&C soil horizons is 90% fines, 10% cobble (Bonner Co. Soil Survey).

***"Guide For Interpreting Engineering Uses of Soils" USDA, Soil Conservation Service. Nov. 1971.

#Land use sediment yield coefficients sources: Pasture (0.055) obtained from RUSLE with the following inputs: Erosivity based on precipitation; soil erodibility based on soils in the watershed; average slope length and steepness by watershed; plant cover of a 10 yr pasture/hay rotation with intense harvesting and grazing; and no support praactices in place to minimize erosion.

Forest Land (0.038) obtained from WATSED with the following inputs: landtype and size of watershed

Unstocked Forest (0.017) obtained from WATSED with the following inputs: Acreage of openings, landype and years since harvest.

Highways (0.034) obtained from WATSED with the following inputs: Value obtained from the Coeur d'Alene Basin calculations.

Double Fires (0.017) obtained from WATSED with the following inputs: Acreage, years since fire and landtype.

Upper Cocolalla Creek Watershed: Sediment Exported To Stream

	<u>Upper Cocolalla Ck</u>
Land use export (tons/yr)	734.4
Road export (tons/yr)	3560.5
Road failure (tons/yr)	0
Bank export (tons/yr)	
poor condition	1047.7
good condition	403.3
Total export (tons/yr)	5745.9
*Natural Background Mass Failure (tons/yr)	0

*Background mass failure is the difference between the total mass failure observed in the watershed, and the mass failure contributed by roads.

Target Load

Upper Cocolalla Creek Watershed

	<u>Acres</u>	<u>Yield Coefficient (tons/ac/yr)</u>	<u>Background Load (tons/yr)</u>
Total Watershed	17,276		
Presently Forested	14,407		
Estimated Historically Forested	16,276	0.038	618.5
Estimated Historically Pasture	1,000	0.55	55
Natural Mass Failure (tons/yr)			0
Background Load = Target Load			
		Target Load	673.5
		Existing Load	5745.9
		Load Reduction	5072.4